C&SF RESTUDY
SENSITIVITY ANALYSIS FOR LEC PUBLIC WATER SUPPLY
SUMMARY OF RESULTS

Definition of the Simulations: All the SFWMM simulations (runs) included in the Public Water Supply (PWS) sensitivity analysis were built from the Alternative 5 run. For each run, the Lower East Coast (LEC) PWS demands were modified from the levels specified in Alternative 5 as follows:

ALT5NOPWS: Demands in Alternative 5 were multiplied by a factor of zero (0.0).
ALT595BSPWS: Demands from the 95 BASE case were used
ALT52XPWS: Demands in Alternative 5 were multiplied by a factor of two (2.0).

The first two runs represent a decrease in PWS demands as compared to Alternative 5, while the last run is an increase in PWS. The Performance Measure Graphics compare four runs: ALT5, ALT5NOPWS, ALT595BSPWS and ALT52XPWS.

The runs were implemented taking into account the following considerations and assumptions:

1 - Location of PWS wells remain the same for all runs as in Alternative 5, except for the ALT595BSPWS, in which the PWS wells are located as in the 95BASE.

2 - LEC irrigation demands remain at the same level (Alternative 5) for all runs. The PWS demands used in the Alternative 5 run include water conservation for the LEC Service Areas, as follows:

SA-1: 16 %	SA-2: 18 %
SA-3: 18 %	SA-4 (North Palm Beach County): 17 %

3 - For all the runs, the same fraction of the urban landscape irrigation demand (resulting in a volume of 254.7 kac-ft/yr) is supplied from PWS, even though the NOPWS run turns off public water demands completely. If the volume of the urban landscape irrigation demand supplied from PWS is made zero, the unsaturated zone will impose an extra load on the groundwater resource to satisfy the landscape irrigation demands. The end result could be to increase groundwater withdrawals when PWS is reduced.

Summary of Results: The general results are summarized in the following points. In the summary, comparisons are mainly against the ALT 5 run, unless otherwise specified.

General:

1 - The results from decreasing PWS are rather mild and marginal in most of the modeling domain areas. In contrast and compared to the PWS reduction case, an increase in PWS generates more drastic effects on several components of the system, such as Lake Okeechobee, the Conservation Areas, the Everglades National Park and the LEC Service Areas. In only a few cases does the decrease in PWS simulations generate magnitude changes larger than the ones observed under the increased public water supply simulation. The system does not appear to behave linearly under changes to the PWS demands.

2 - In general, the west portions of the system, such as the Rottenberger WMA, the Holey Land, the BCNP and western WCA-3A and western ENP, do not get affected by either change in PWS. The closer a system element is to the Service Areas the more sensitive that element is to changes in PWS.

Lake Okeechobee and Lake Okeechobee Service Area:

3 - Lake Okeechobee stages marginally increase with the decrease in PWS. The increase in PWS generates a very large decrease in stages. Lake Okeechobee pays a large toll for the increase in PWS. For instance, the percent of the time at or below 14 ft. goes from 14% for ALT5 to 34% for the 2XPWS run. At some points, the stage duration drops 1.5 or 2.0 ft. For the same run, regulatory releases from the Lake also decrease by 183 kac-ft/yr (24%) with respect to ALT 5. Also, the number of undesirable low stage events increases.

4 - The percent of demands not met for the Lake Okeechobee Service Areas behaves in a non-linear manner. Decrease in PWS generates a slight decrease in the percent of demands not met, while major increases are observed in the indicator when PWS is doubled. This is due to the resulting impacts on Lake Okeechobee stages, which influence the water use cutbacks in the Lake Service Area.

Remaining Everglades and Big Cypress National Preserve:

5 - Most of the Indicator Regions in the Big Cypress Preserve and the western portion of WCA-3A show no changes in stages when PWS is increased or decreased.

6 - Most of the Indicator Regions for WCA-1, WCA-2A and eastern WCA-3A show a moderate decrease in stages when PWS is increased, with practically no variation under PWS reductions. Increase in PWS induces major to large decreases in stages for south WCA-1, WCA-2B and WCA-3B. As before, the closer a particular region is to the East Coast Protective Levee, the more affected it gets by the increase in PWS demands.

7 - Indicator Regions for Shark River Slough in the ENP show marginal changes in stages, when PWS in decreased. Increased PWS translates into a reduction in stages for Shark River Slough. The stage reductions generated by increased PWS are larger than the stage increases induced by decreases in PWS.

8 - Table 1 shows how flows, related to major sections in the ENP, behave under the different runs. Again, major changes are associated to the increase in PWS. The NOPWS run exhibits an important increase in the magnitude of the flows entering and leaving the Park. This is produced mainly by an increase in the structure discharges from the LEC to ENP (via the S332 and S356 set of structures).

Table 1. Mean Annual Flows (kac-ft/yr) for Major sections in the ENP

Run	Overland flow south of Tamiami Trail		Overland flow west Shark River Slough		Overland flow south Florida Bay		Structure flows from LEC	
	Flow	% (*)	Flow	% (*)	Flow	% (*)	Flow	% (*)
ALT5	890		1083		169		598	
NOPWS	933	5	1206	12	182	8	759	27
95BSPWS	906	2	1138	5	175	4	675	13
2XPWS	741	-17	841	-22	149	-12	359	-40

(*) % change with respect to ALT 5

9 - In terms of hydroperiod improvement and hydroperiod matches, no run can be identified which would produce a definite improvement for the Remaining Everglades, as compared to ALT 5. For ponding matches with the NSM, the 2XPWS run shows improvement for the WCA System. The ENP loses in terms of ponding matches, in going from the ALT5 to the 2XPWS run. This behavior is the result of less water available in the Remaining Everglades, which generates a reduction in the ponding depths, or a shift towards smaller depths for the ponding depth distribution. This coincidentally results in an improvement for most of the WCA's. Reduction in PWS produces practically no changes in hydroperiod matches, yet another example of the non linear behavior of the system.

10 - Increase in PWS tends to decrease hydroperiods in the WCA system, especially for cells close to the East Coast Protective Levee. Northern WCA-3A also experiences shorter hydroperiods and so does the ENP, especially around NE Shark River Slough and the regions close to the SDCS. Decrease in PWS slightly increases hydroperiods in the Northern portion of WCA-1 and around NE Shark River Slough.

11 - Hydroperiod matches switch to the shorter duration side around Shark River Slough and North WCA-1 when PWS is increased. The changes in the indicators for hydroperiod improvement and hydroperiod matches generated by an increase in PWS tend to be larger than the changes induced by the reductions in PWS.

12 - An increase public water demands generates shallower ponding depths in Shark River Slough, WCA-3B and Eastern WCA-3A. A decrease in PWS generates slightly higher ponding depths at the south western tip of Shark River Slough.

Lower East Coast Service Areas:

13 - As shown in Table 2 and Figure 1, the amount of water discharged to tide from the Service Areas increases when PWS is decreased and decreases when PWS is doubled. Volumes discharged to tide is the only indicator for which decreasing PWS has a larger or similar response as compared to the simulation increasing PWS, in terms of magnitude. The large volumes discharged to tide when PWS is turned off indicate that ALT 5 makes large use of local runoff and local storage to recharge the aquifer and supply the public demand. Despite the good use of local sources noted above, reductions observed in the 2XPWS run are still substantial. Note how the effects tend to be more drastic as the analysis moves south from Service Area 4 (North Palm Beach County Service Area) to Service Area 3. The slope values in Figure 1 indicate that SA-3 and SA-4 will yield the largest decrease in flows to tide per unit increase in PWS. This is a direct result of the lower subsurface storage capability (lower land elevation and smaller depth to the water table) in service areas 3 and 4.

14 - Duration curves for the indicator regions and individual cells in the LEC show that stages in the Service Areas tend to get equally affected by either reduction or increase in PWS. For a few of the LEC individual cells, observed changes are small (up to 0.2 ft), other cells exhibit large changes (0.2 - 1.0 ft), with the remaining cells (40 %) involving changes in stages in both directions of up 2.0 to 3.0 ft. This is the only indicator which appears to behave linearly, in most of the cases, under PWS demand changes. Also of particular interest for this indicator is the fact that changes for several cells are substantial in both directions. Due to the averaging operation incorporated in the indicator region performance measure, the changes observed in stage duration in the indicator regions are smaller than the ones for the individual cells.

15 - For some cells in the LEC, the ALT595BSPWS run will generate stages similar or lower than those found in ALT5. This is due to the 95 BASE location of the PWS wells. Typically the 95 BASE has more wells located closer to the coast.

16 - As shown in Table 3, regional water supply deliveries are directly, but not proportionally related to PWS. When PWS is increased, the amounts required from Lake Okeechobee and the WCA system quadruple and the dependency on reservoirs increases by a factor of three, as compared to ALT5. Note how deliveries from ASR get affected in a very different fashion, compared to the other sources. The volume of regional water supply deliveries is another indicator which exemplifies quite well the non linear behavior of the system. When PWS demands decrease, the dependence on the regional system decreases, but to a much lesser degree than the increase in PWS increases the dependency.

Table 2. Mean Annual Flows (kac-ft/yr) to Tide for each Service Area

SA	SA-1		SA-2		SA-3		SA-4		Totals	
Run	Flow	% (*)	Flow	% (*)	Flow	% (*)	Flow	% (*)	Flow	% (*)
ALT5	416		455		895		465		2231	
NOPWS	576	39	645	42	1404	57	511	10	3136	41
95BSPWS	478	15	476	5	1054	12	485	4	2493	12
2XPWS	296	-29	365	-20	639	-29	415	-11	1715	-23

(*) % change with respect to ALT 5

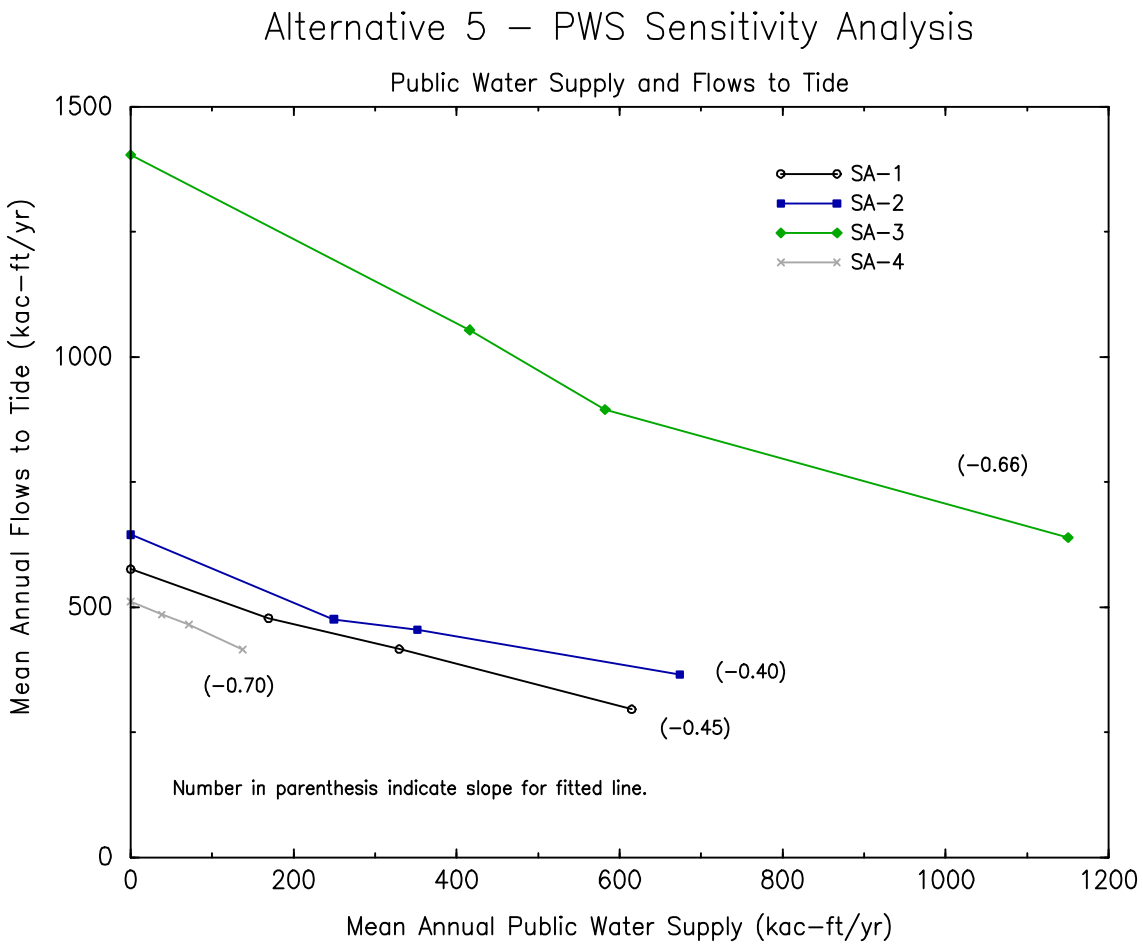

Table 3. Summary of Average Annual Regional Water Supply Deliveries (kac-ft/yr) to SA-1, SA-2 and SA-3.

Run	Source of Deliveries			
	WCA System	Lake Okeechobee	ASR	Reservoirs
ALT5	88	56	103	67
NOPWS	18	41	40	1
95BSPWS	62	45	62	37
2XPWS	338	222	94	179

17 - Increase in PWS generates drastic increases in the frequency, level and severity of PWS cutbacks for most of the LEC Service Areas (Table 4). In some cases, the 95BSPWS run appears to increase the frequency of water restrictions. However this is attributed to the fact that 95BASE well location are typically closer to the coast where salt water intrusion trigger wells are more affected. Also, in the 2XPWS run public water demands are not redistributed in space.

18 - Even though the NOPWS run imposes no PWS demands on the system, certain long water restriction periods remain in the simulation. These periods and their durations are identified as follows:

+ LOSA: 16 months, March 1981 to June 1982
+ SA-1: 14 months, November 1977 to May 1978 and November 1981 to May 1982
+ SA-2: 18 months, November 1977 to May 1978, November 1981 to May 1982 and February 1990 to May 1990
+ SA-3: 14 months, November 1977 to May 1978 and November 1981 to May 1982
+ SA-4: 14 months, November 1977 to May 1978 and November 1981 to May 1982

Under the NOPWS simulation, other demands, such as LEC irrigation and LOSA demands, remain in the system. Also, the model still attempts to maintain the LEC canals at specified minimum elevations, so that saltwater intrusion is minimized.

19 - Table 4 summarizes supply and cutback volumes for the LEC Service Areas, for the different demand types. It can be easily verified that demands for the 2XPWS and the ALT5 runs are in a 2:1 ratio. As stated before, irrigation demands for the LEC remain constant across the different model runs. As expected, major cutbacks for all type of demands appear under the 2XPWS run.

Table 4. Supply and Cutback Volumes in (1000 ac-ft) for different demand types and for each Service Area, for the 1965 to 1995 Simulation Period.

Serv. Area and Type	ALT5		ALT5NOPWS		ALT595BSPWS		ALT52XPWS	
	Supply	Cutback	Supply	Cutback	Supply	Cutback	Supply	Cutback
SA-1								
PWS	10216.54	57.97	0.00	0.00	5241.96	33.12	19058.08	1490.93
ULSC	4553.82	0.00	4553.82	0.00	4553.82	0.00	4542.23	11.58
NURSERY	596.58	0.00	596.58	0.00	596.58	0.00	591.93	4.64
GOLF	1093.69	1.31	1094.11	0.89	1091.49	3.50	1013.14	81.85
AGLVOL	147.11	0.00	147.11	0.00	147.11	0.00	147.11	0.00
AGOVH	505.42	0.00	505.42	0.00	505.42	0.00	503.86	1.56
AGOTHR	86.28	0.00	86.28	0.00	86.28	0.00	85.74	0.53
SA-2								
PWS	10906.07	158.73	0.00	0.00	7723.17	124.66	20880.39	1249.20
ULSC	6049.77	0.00	6049.77	0.00	6049.77	0.00	6046.94	2.82
NURSERY	267.24	0.00	267.24	0.00	267.24	0.00	265.54	1.71
GOLF	767.84	10.37	769.57	8.65	766.30	11.92	723.71	54.50
AGLVOL	0.47	0.00	0.47	0.00	0.47	0.00	0.47	0.00
AGOVH	1.13	0.00	1.13	0.00	1.13	0.00	1.12	0.00
AGOTHR	142.29	0.00	142.29	0.00	142.29	0.00	141.53	0.76

SA-3								
PWS	18042.67	103.94	0.00	0.00	12892.01	66.92	35653.61	639.61
ULSC	7007.75	0.00	7007.75	0.00	7007.75	0.00	7007.75	0.00
NURSERY	952.44	0.00	952.44	0.00	952.44	0.00	952.44	0.00
GOLF	310.92	0.47	310.60	0.79	310.96	0.43	309.18	2.21
AGLVOL	653.18	0.00	653.18	0.00	653.18	0.00	653.18	0.00
AGOVH	1428.06	0.00	1428.06	0.00	1428.06	0.00	1428.06	0.00
AGOTHR	222.24	0.00	222.24	0.00	222.24	0.00	222.24	0.00
SA-4								
PWS	2214.55	13.27	0.00	0.00	1182.87	5.80	4253.87	201.74
ULSC	1248.66	0.00	1248.66	0.00	1248.66	0.00	1244.13	4.54
NURSERY	55.66	0.00	55.66	0.00	55.66	0.00	55.02	0.64
GOLF	569.75	0.56	569.98	0.33	569.57	0.74	539.01	31.30
AGLVOL	57.15	0.00	57.15	0.00	57.15	0.00	57.15	0.00
AGOVH	37.68	0.00	37.68	0.00	37.68	0.00	37.61	0.08
AGOTHR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PWS: Public Water Supply
ULSC: Urban Landscape Irrigation
NURSERY: Nursery Irrigation
GOLF: Golf Course Irrigation
AGLVOL: Agricultural Low Volume Irrigation
AGOVH: Agricultural Overhead Irrigation
AGOTHR: Agricultural Other Irrigation